HGB:AER

DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS
WASHINGTON

Technical News Bulletin No. 48.

April 7, 1921.

GENERAL NOTE.

Owing to the current nature of the investigations mentioned in the Technical News Bulletin, sometimes it will be impossible to supply printed information regarding them. However, in these cases, when the investigation has progressed sufficiently far, the Bureau will be pleased to furnish technical data to those engaged in the particular application of the subject, in order to avoid the delay incident to publication.

-o-O-o-

1 Ignition Points and Spontaneous Ignition

The Bureau receives frequent inquiries relative to the ignition points of materials and the fire hazards incident with their storage and use, and a few determinations have recently been made in response to specific requests. The average value for a type of newspaper stock was found to be 330°C., ignition occurring after between 2 and 3 minutes exposure. For nitro-cellulose motion picture film, values from 190 to 210°C. were found, after exposures ranging from 3 minutes to one-half minute, the lower temperatures being generally incident with the longer exposure periods, although the method used did not permit determining the relation definitely. The results range about 20° higher than in determinations previously made on celluloid (Technologic Paper No. 98).

A wool and cotton insulating felt which had been considered as a possible cause of fire, due to spontaneous combustion, was tested with negative results at 50 and 100°C., heating being continued for 3 days at each temperature. After a further temperature rise over 2 hours, the specimens ignited at about 250°C. While little experimental data are available, fire records indicate that the ignition point of a large number of combustible materials is greatly lowered by

long-time exposure. Fires in textile fabrics, wood, and wood products have been attributed to temperatures not much in excess of 100°C., although there is possibility in many cases that the fire originated from other causes.

2 A Cause of Airplane Engine Failures and Disasters

Unquestionably a snow-storm may cause a plane to crash. The assertion that a plane may come to grief from a snow-storm of which it is itself the cause is, nevertheless, startling. Recent experiments at the Bureau of Standards have shown such an occurrence to be by no means impossible. This snow-storm, however, is not one that is seen by the pilot, but one that takes place in the intake manifold of the engine.

Since the altitude laboratory makes possible the testing of airplane engines under service conditions, it is to be expected that many of the troubles occurring in service will be experienced in these tests. Laboratory tests offer exceptional opportunities for tracing such troubles to their origin, because under such conditions so many more quantities are measured than in service. This instance furnishes an excellent illustration.

During some of the Bureau's investigations, when the existence of trouble became apparent from a decrease in engine power, measurements showed the rate of air flow to have decreased as would have been the case had the drop in power been occasioned by closing the throttle. Tests in the carbureter test plant had shown that such a throttle action might be produced by the formation and collection of snow in the induction system. The snow itself had been observed through a glass section of this system. Snow thus appeared a very probable source of the difficulty.

To form snow, two conditions must be met: (a) moisture must be present and (b) the temperature must be low enough to freeze this moisture. Indirectly, both of these conditions may be satisfied by the vaporization of fuel in the inlet system. This vaporization requires heat, much of which is supplied by the mixture. As a consequence, under certain conditions, the temperature will drop below the freezing point. A decrease in temperature decreases the weight of water vapor that a unit volume of air can contain and the surplus condenses. Hence, the temperature drop produced by the vaporization of the fuel may result both in the condensation of moisture and lowering the temperature to the freezing point of water, and hence satisfy both conditions necessary for the formation of snow.

Actual proof that snow was the source of trouble was not hard to obtain. The test equipment is so arranged that the air passes over heating grids on its way to the engine. Increasing the air temperature 20°C. or more by this method cured the trouble in every instance. The set-up also permits the air for the engine to be taken over refrigerating coils, thus being cooled to a temperature so low that it can contain almost no moisture. This air is then reheated to the desired temperature. It was found that air so treated permitted satisfactory engine operation at those temperatures where trouble was encountered with the air from which the moisture had not been removed.

It will be readily appreciated that the starting point of this trouble is the drop in temperature brought about by the vaporization of the fuel. The cure obviously is to supply sufficient external heating to prevent this temperature drop. How much external heating is necessary to attain this end can be calculated from knowledge of the heat of vaporization of the fuel.

The chief danger from this source is not that it causes a decrease in power, but that it results in violent fluctuations of power which can neither be predicted nor controlled by the pilot. These fluctuations are produced when fragments of the snow are dislodged and result in changes of speed similar to those produced by suddenly opening the throttle. Moreover, if such trouble is instrumental in causing disaster to the plane, the snow will all melt before the engine can be torn down for examination. There is then left nothing to substantiate the pilot's report of engine trouble.

There is an unfortunate tendency to attribute all accidents for which no satisfactory explanation can be found to the fault of the pilot. It is believed that the above information will explain some of these disasters for which pilots have been unjustly blamed.

3 Partial Immersion Thermometers

Most of the thermometers made and sold for laboratory use in this country have been of the so-called total immersion type, that is, they were pointed and graduated to read as nearly as feasible, correct temperatures when immersed so that the bulb and the whole of the mercury column were at the same temperature. It is only in rare cases, however, that thermometers, especially those used at high tempera-

tures, are immersed more than a few inches. Under such conditions, the thermometers read too low, and a so-called stem correction should be applied. However, the proportion of those engaged in chemical or similar work in this country, who are both able and willing to go to the trouble of calculating and applying such stem corrections, is perhaps 1 in 10 000. It is, therefore, in general preferable, that partial immersion thermometers should be used in ordinary laboratory work. This year for the first time the General Supply Committee has specified partial immersion thermometers for general use in government laboratories and the American Chemical Society's committee on Guaranteed Reagents and Standard apparatus has recommended the use of the same specifications which were prepared by the Bureau of Standards. A note on total and partial immersion thermometers, in which the advantages of the two classes of thermometers are set forth, has been published in the Journal of Industrial and Engineering Chemistry for March, 1921.

5 Investigation of Body-Bound Bolts

The Bureau has been conducting an investigation on the experimental use of liquid air and an explosive charge for body-bound bolts. The request for this work came from another government department and if the practical application of the methods proves successful, such bolts would be of considerable value in certain situations. Two methods of obtaining a tight fit between the bolt and the material surrounding it were used in an effort to find one which would give sufficient strength under severe shearing stresses. The first method employed liquid air, while in the second an explosive was used.

In the first method the bolt is immersed in the liquid air until it has contracted sufficiently to allow it to enter the holes in the plates. As the bolt warms, it expands, resulting in an extremely tight fit. In the second method, the bolt is inserted as a loose fit and has a small hole along its axis in which an explosive charge is placed. When this charge is fired, it expands the bolt rendering it a tight fit.

Before the two methods above mentioned were tried, experiments had been made on cylindrical pins which were from 0.001 to 0.0015 inch larger than the holes and which were contracted to fit the holes by immersing in liquid air. Tests had also been made on tapered pins which were contracted in the same way and driven

into tapered holes. The results of the investigation on the use of liquid air showed that a tighter fit can be obtained with tapered pins than with the cylindrical pins. The average unit frictional resistance as shown by the tests on cylindrical pins was 2 150 lb. per sq. in. while the average value for the tapered pins was 3 000 lb. per sq. in.

The test of the bolts expanded by explosive charges shows that satisfactory results can be obtained by the method as the average unit frictional resistance was 2 180 lb. per sq. in. The tightness of the fit is dependent upon the size of the hole bored in the axis of the bolt to contain the powder charge as well as upon the pressure of the explosion.

5 Effects of Strain in Optical Glass

In the process of annealing optical glass, it is very difficult to completely free large blocks of glass from internal stresses. An investigation has been started in order to determine the effect of slightly strained glass on the performance of an optical system. Prisms having various amounts of strain are introduced into an otherwise good optical system and the effect of the strain is observed. After the magnitudes of the strains have been measured, it is hoped that some relationship may be found between the stresses and the effect on the definition of the instrument in which the glass is used. Thus we may be able to specify the minimum tolerance for strain in optical glass.

6 Specifications for Marine Sextants

Bureau of Standards' Circular 110 on this subject may be obtained from the Superintendent of Documents for 5¢ per copy. These specifications, incorporating standard practice in design and performance of sextants, are the basis for certificates issued by the Bureau of Standards. They cover the rigidity, durability, convenience of operation, and mechanical perfection of the instrument; range and accuracy of the scales; consistent tolerances for the mirrors, shade glasses, and telescopes; and provisions for adjustment and replacements.

New instruments are expected to conform closely with these specifications or represent improvements. The precision required of old instruments is placed somewhat below that required of new in order that those which are still serviceable and reliable may not be excluded from certification.

7 Smoke Masks for Use of the District of Columbia's Fire Department

A request was received from the District of Columbia Fire Department to assist the Chief Engineer in the preparation of specifications for smoke masks and in training the men in their use. A special "smoke house" is being equipped for this purpose. Conferences with the Chief Engineer have been held and plans for the work have been made. The characteristics of different types of masks have been discussed in relation to requirements for fire fighting and comparative tests on them will soon be made. Valuable advice on the smoke aspect and the illuminating gas aspect of this question has been obtained from two specialists in these subjects who were connected with the Chemical Warfare Service during the war.

8 National Electrical Safety Code

Handbook No. 3 of the Bureau of Standards has recently been published and may be obtained from the Superintendent of Documents at 40¢ per copy. This new edition is a book of pocket size and the discussion of the rules has been segregated in a separate volume which will appear later as Handbook No. 4.

In addition to two introductory sections giving definitions of terms and rules for the grounding of apparatus and circuits, the Code consists of four principal parts as follows:

(1) Rules for the installation of machinery, switchboards, and wiring in central stations and substations; (2) rules for the construction of overhead and underground lines for the transmission and distribution of electrical energy and intelligence; (3) rules for the installation of electrical apparatus and wiring in factories, residences, and wherever electricity is utilized for light, heat, or power; (4) rules for safeguarding employees when working near electrical machines or lines.

9 Notation for Electron Tube Circuits

The increasing use of electron tubes in radio communication has been accompanied by the appearance of a large number of papers in the technical press in which circuits for using electron tubes for generating, detecting, amplifying, and other purposes are discussed. Because of the large number of quantities and circuits for which symbols must be used and the diversity of notation employed, it has become difficult to read papers on this subject.

Certain well-defined practices have become common, however, and it appears possible to establish a reasonably consistent notation which may be employed as a basis for all discussions on electron tubes. While there is no way of avoiding a rather elaborate

set of notation, it can be made to combine simplicity, current practice, and consistency. A paper has been prepared in which such a notation is proposed. Current practice and consistency are retained as far as possible and it is believed that the adoption of this notation in all papers on electron tube theory and applications would go far to make them much more readily understood and, therefore, of greater value to workers in this field.

10 Elementary Information for Radio Amateurs

The Bureau of Standards has been receiving an increasingly large number of inquiries regarding such radio problems as circuit diagrams, the uses of various kinds of radio apparatus, and the principles of operation of radio antennas and other equipment. Many of the simpler of these problems are answered satisfactorily by the elementary radio books now on the market or by articles in current amateur radio periodicals.

The radio laboratory of the Bureau of Standards has, therefore, prepared a report giving a list of sources of elementary radio information. This report gives the names and addresses of the principal radio periodicals in this country as well as a list of the best known books which give elementary radio information in a way which can be understood by the radio amateur.

This report also explains how to secure various government publications dealing with radio subjects, including the Radio Communication Laws of the United States and lists of radio stations of the United States with their call letters.

11 Progress Report of the National Screw Thread Commission

This report has been issued as Miscellaneous Publication No. 42 of the Bureau of Standards and is for sale by the Superintendent of Documents at 15¢ per copy. In this report, the following fundamentals have been established:

(1) Definitions of screw thread elements and all terms entering into screw thread standardization; (2) Standard thread form. Thread angle = 60°, flat at crest = 1/8 pitch; (3) an adequate system of screw threads consisting of a coarse thread series and a fine thread series; (4) four kinds or classes of fit with allowances and tolerances for 3 of the 4 classes established; (5) an adequate gaging system for inspecting the manufactured product.

This report has been fully abstracted in Lefax; Mechanical Engineering (Journal of the American

Society of Mechanical Engineers) June, 1920; Machinery, July, 1920, and with certain corrections in the August number, and the American Machinist, September 9 and 16, 1920.

12 Pure Platinum

The question has been raised of the possibility of contamination of platinum melted in magnesia crucibles because of the small amounts of flouride used as a binder. In order to investigate this subject, a crucible was made from pure magnesia using no binder. This was used in the same manner as in previous tests, namely: in the absence of carbon and under a vacuum of 3 mm of mercury. The platinum melted in this crucible contained a very noticeable amount of magnesium.

13 Examination of Locomotive Crank Pin

A short time ago the Interstate Commerce Commission submitted a portion of a broken locomotive crank pin which was the cause of a wreck on one of the Eastern railroads. It was requested that an examination of the pin be made to ascertain the probable cause of failure. A summary of the Bureau's report to the Commission shows: "(1) that the material is satisfactory in that it meets the required specifications; (2) that the fracture was of the fatigue type and originated on the outside surface of the pin, presumably being localized by some surface defect; and (3) that the mechanical properties of the material may be very materially improved by further heat treatment so that the ability to withstand failure of this type should be very considerably increased. In view of the uncertainty which exists concerning the service conditions which serve to localize a break, it cannot be claimed that failure would not ultimately occur regardless of the structural condition and mechanical properties."

14 Recent Metallurgical Publications

The following articles have appeared during the past month in Chemical and Metallurgical Engineering:

"Macroscopic examination of metals" by H. S. Rawdon. A brief statement of the defects which may be revealed by visual examination of etched smooth surfaces of steel and other alloys. Physical unsoundness and internal strain may be detected by special methods.

"Preparation of Small Metal Specimens for Microscopic Examination" by H. S. Rawdon.

"The Thermal Characteristics of Arc Fused Iron" by H. S. Rawdon. This is a short contribution to the discussion of a paper by J. W. Owens on the "Effect

of Nitride on the Heat Treatment of Arc Welded Steel" before the American Welding Society.

"Welding Practice" - Letter Circular VIII-8. A rather comprehensive discussion of the various types of welding and the limitations and advantages of the different types has been prepared and will form the basis of the above-mentioned circular which will be issued as a part of the series of the Metallurgical Division.

15 Recent Chemical Publications

"The Determination of Iron by the Cupferron Method" by G. E. F. Lundell will appear in the April number of the Journal of the American Chemical Society.

"The Determination of Cobalt and Nickel in Cobalt Steels" by G. E. F. Lundell and J. I. Hoffman has been accepted by the Journal of Industrial and Engineering Chemistry.

16 Modification of Government Paper Specifications

A representative of the paper section of the Bureau attended several conferences with the Interdepartmental Committee in regard to the proper specification for paper for envelopes used in the government departments. Various changes were made in these specifications which render them more uniform and which eliminate manufacturers names.

Specifications for lime in the manufacture of sulphite pulp were submitted to the Interdepartmental Conference on chemical lime. These were adopted without many changes and are now being submitted to the manufacturers.

17 Scale for Weighing Tree Sap

Recently one of the government departments called upon the Bureau for advice in reference to securing the most suitable type of scale for investigations in the turpentine field where the sap yielded by individual trees must be weighed. It was found that a small portable scale already on the market met the requirements very well and arrangements were immediately made for securing one.

18 Weights and Measures Inspections

The mayors or other officials of six cities requested information concerning the establishment of weights and measures inspection departments, and the Bureau furnished data for drafting a suitable ordinance on the subject, and advice concerning the organization and practical conduct of such a service. Of these six cities, 3 are in Louisiana, 2 in New Mexico, and 1 in

Mississippi. None of these states have departments for the supervision of the inspection of weights and measures, and, consequently, there is no state official to whom cities may apply for information and assistance in establishing a weights and measures inspection service. The importance, therefore, is obvious of a national Bureau which can aid communities in those states which have not yet taken up the important matter of general supervision of weights and measures.

19 Present Status of Grain Scale Situation

The representative of the Bureau at the last annual meeting of the National Scale Men's Association held recently in Chicago, delivered a paper on the subject of the present status of the grain scale situation and also was quite frequently called upon for information concerning other subjects which were discussed at the meeting.

20 Colorless Waterproofing Materials for Building Stones

The exposure tests on sandstone and limestone, after a 4-month period, indicate that several proprietary materials are effective in reducing the absorption of moisture by the stone to 5% or less than that of the untreated specimens. However, all of the exposure specimens continue to indicate a slight increase of absorption as the test progresses.

21 Discoloration Tests of Indiana Limestone

A large sample of Indiana limestone which had become discolored after a period of exposure has been dissolved and the brown residue analyzed. The analysis indicates that the material is organic matter of a coaly nature and that the limestone contains about 1/10 of 1% of this substance.

22 Standard Cement Fineness Sample

The supply of standard cement fineness sample 46-f is becoming depleted and the Bureau has found it necessary to commence preparation of a new sample to be known as 46-g. The cement for this sample has been selected and during the coming month it will be ready for use, that is, for the testing of sieves and for general distribution.

Respectfully,

S. W. STRATTON

Director
HGB